AMSAT™

Affiliated with ARRL

NEWSLETTER

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AMSAT-OSCAR 7 LAUNCH ISSUE AND MEMBER RENEWAL FORMS

AMSAT-OSCAR 7 LAUNCH DATE: OCTOBER 23, 1711 GMT

AMSAT OFFICERS

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Perry I. Klein, K3JTE

Executive V.P.:
Jan A. King, W3GEY

Command Station Mgr.:
Randall Smith, VE2BYG

V.P. Operations:
William A. Tynan, W3KMV

Secretary:
Charles Dorian, W3JPT

Treasurer:
William A. Hook, W3QBC

Membership Chairman:
Richard N. Coan, W3CPU

Editor for this issue:
Perry I. Klein, K3JTE

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AMSAT NETS

In order to keep the satellite users in touch with each other and to provide information to newcomers, the following AMSAT nets meet regularly:

North American East Coast 75 Meter Net

Mondays 9:00 p.m. EDT (0100Z Tues)

3850 kHz LSB

Net Control W3ZM, W3TMZ or K2GUG

After the change to Standard Time, the net will meet at 7:00 p.m. EST (0000Z Tues).

North American West Coast 75 Meter Net

Mondays 7:00 p.m. PDT (0200Z Tues)

3850 kHz LSB

Net Control W6OAL or W6EJJ

Note that East Coast and West Coast Nets are now on the same frequency, so stations in between should be able to work both. After the change to Standard Time, the net will continue to meet at 7:00 p.m. PST (0300Z Tues).

International 20 Meter Net

Sundays 1800Z*

14,280 kHz USB

Net Control W3ZM, W3TMZ or others

International 15 Meter Net

Sundays 1900Z

21,280 kHz USB

Net Control W3ZM, W3TMZ or others

Western Europe Net

Sundays 0915Z

3780 ±10 kHz LSB

Net Control G3IOR

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*G3IOR listens at 1730Z for European and African check-ins.

JA Net

Mondays 1300Z

3560 kHz LSB

Net Control JA1ANG

Southeast Asia Net

Thursdays 1300Z

14,320 kHz USB

Net Control JA1ANG or others

ZL Net

Mondays, Thursdays and Saturdays

7:00 p.m. NZT

3850 kHz LSB

Net Control ZL1WB

In addition, the frequencies 3850 kHz LSB and 14,280 kHz USB are designated as general watch frequencies for discussions of satellite matters following passes.

In the Washington area, AMSAT traffic is handled via 2 meter FM on 146.85 MHz simplex and through the AMSAT repeater WR3ABU (146.25 to 146.85 MHz).

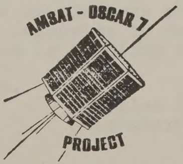
In southern California, the WR6ACJ repeater (146.25 to 146.85 MHz) has been designated as an official medium for exchanging information relating to the amateur space program. It is suggested that those in other areas also adopt 85 simplex and the 25/85 repeater combination for satellite discussions. In those areas where such repeaters already exist, check with the present inhabitants of the channel to see if they would mind having their facility used for such a constructive purpose as satellite talk. If we all standardize on this frequency combination, it will be much easier to get in touch with each other when traveling.

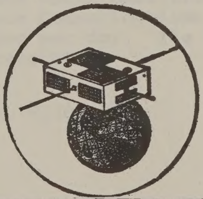
Readers are requested to inform AMSAT relative to corrections, additions or deletions to the above net schedules.

Bulletins of general interest to those interested in amateur satellites are broadcast regularly on OSCAR 6 reference orbits (first orbit of the Greenwich day) at approximately 10 minutes after ascending node. These bulletins are transmitted on a downlink frequency of approximately 29,490 kHz and can be received over most of eastern North America.

AMSAT-OSCAR 7 STAMP NOW AVAILABLE

A new AMSAT-OSCAR 7 rubber stamp is now available from Al Simpson, WA5TJB, 1005 East "I" Street, Russellville, Arkansas 72801, for $4.00U.S. postpaid. An AMSAT-OSCAR 6 stamp is also available, for $3.50. For shipment outside North America, please include an additional $1.00 for airmail postage. The artist's conception of OSCAR 7 was provided by Steve Hay, K5RZU and his staff at the Hesse Envelope Company in Dallas, Texas.





FROM THE PRESIDENT'S DESK

by Perry Klein, K3JTE

The purpose of this report is to summarize recent AMSAT activities in connection with the AMSAT-OSCAR 6 and AMSAT-OSCAR-B (AMSAT-OSCAR 7) amateur satellite projects.

The AMSAT-OSCAR 6 satellite, launched on October 15, 1972, has now been in operation nearly two years, approaching twice the lifetime originally anticipated. The spacecraft appears to have gone through its critical seasonal periods of maximum and minimum sun (occurring during February and June) for the second time without serious degradation. It is hoped that through the continued judicious use of intensive ground telecommand, we will be able to realize further longevity with the satellite for some time beyond its second birthday.

The extended operation of AMSAT-OSCAR 6 beyond its original one-year lifetime goal has brought up questions concerning how AMSAT-OSCAR 6 should best be used during the period when AMSAT-OSCAR 7 goes into fulltime service later this year. It is expected that there may be some conflicts in operation between the two satellites since the orbits are planned to be nearly identical, and there is some overlap in the frequencies of the three linear repeaters that will be in operation between the two satellites. The tremendous amount of time and workload required to keep AMSAT-OSCAR 6 from permanently damaging its batteries and to keep it operating according to the published operating schedules will certainly prove to be an even more serious burden when AMSAT-OSCAR 7 is in orbit and in service.

To date, our official AMSAT-OSCAR 6 Users Directory, which is published regularly in the Radio Amateur Callbook, numbers over 2,400 stations from 86 countries, with about 63 percent of the users located outside the continental United States. Of all the users,reports have been received from slightly over 500 stations. The user population continues to increase at an average of about 100 per month. All 50 states are in regular operation, and 16 stations have now qualified for AMSAT's unique OSCAR 6 Worked All States trophy.

AMSAT-OSCAR-B is continuing to undergo final modifications and tests toward a launch, which has now been set by NASA tentatively for October 23, 1974, just past the second birthday of AMSAT-OSCAR 6. The spacecraft went through its first thermal-vacuum test during mid-May, and six weeks were required to modify several of the subsystems as a result of this test. The final thermal-vacuum test, solar simulation, and vibration test were completed during August and September.

The Federal Communications Commission has granted AMSAT a five-year license for AMSAT-OSCAR 7 and assigned the call letters W3OHI in what is probably the first license for an amateur-satellite service space station. Unfortunately, the F.C.C. has denied us permission to operate the 2304.1 MHz telemetry beacon, built by members of the San Bernardino Microwave Society, although the Commission has no objections to our flying it.

Looking to the future, AMSAT's immediate problem is securing the $50,000 - $100,000 minimum level per year needed for our organization to continue to build satellites. We would like to look toward Phase III of the amateur satellite program, the synchronous orbit phase. If funding can be obtained, we hope to develop a SYNCART (Synchronous Amateur Radio Translator) package with a view toward flying it on a planned synchronous satellite.

AMSAT BOARD OF DIRECTORS MEETING

March 29, 1974

The meeting was called to order at 8:10 p.m. by President Klein, K3JTE, at the home of the Secretary, C. Dorian, W3JPT.

The following directors and officers were present:

Perry Klein, K3JTE	William Tynan, W3KMV
William Dunkerley, WA2INB	Jan King, W3GEY
William Hook, W3QBC	Charles Dorian, W3JPT.

In accordance with the recommendations of the President, the following appointments were made and approved by the Board.

R. Smith, VE2BYG, as Command Station Manager;
R. Coan, W3CPU, as Membership Chairman;
AMSAT Nederland, as AMSAT's affiliate in the Netherlands;
Japan AMSAT Association, as AMSAT's affiliate in Japan;
C. Dorian, W3JPT and Bill Tynan, W3KMV, as AMSAT representatives to the Northern Virginia Amateur Radio Council; and
N. Chalfin, K6PGX, as AMSAT's attorney in Trademark/Patent office matters.

The Board approved authorization for three travel requests:

P. Klein to New York City for an AMSAT presentation at the IEEE International Convention;
W. Tynan to the Dayton Hamvention; and
L. Kayser to Washington, D.C., for the A-O-B test program.

The President advised a change in the membership application form. This change is required in order to obtain a 2nd class mailing permit. In support of the permit, it was agreed to designate $3.00 of the dues as the subscription charge for the quarterly AMSAT Newsletter but inseparable from membership dues.

The Board approved a reduction in the AMSAT-OSCAR 6 operating schedule effective April 1 in order to conserve battery power since the satellite will be receiving less solar energy in the coming months. The morning "on" passes will be discontinued except for specifically approved educational program and bulletins.

A report was made by Jan King on possible future projects:

144/435 MHz linear repeaters
24 Channel analog telemetry encoder
Flashing beacon experiment.

It was agreed to affirm the understanding that Project OSCAR would integrate the various systems for OSCAR 8.

President Klein discussed a proposal to be submitted to the ARRL Foundation on long lead-time systems for future satellites - i.e., OSCAR 8. Comments were requested.

The Board was advised of revisions to the "AMSAT-OSCAR 7 Technical Operations Plan" and comments were invited. The Board reviewed the approach to be taken to the FCC Notice of Inquiry, Docket 19852 on the Amateur Satellite Service. The President is to coordinate the AMSAT reply based on the Directors' inputs to him.

W. Dunkerley reported on the efforts and progress of the OSCAR Educational Program. As a result of mailing 30,000 newsletters on "Space Communications for Educators," ARRL Headquarters has been receiving 50 responses per day. The efforts of four persons are now involved in handling this program.

The meeting adjourned at 12:25 a.m.

Charles Dorian, W3JPT
Secretary

AMSAT GENERAL MEETING

June 15, 1974

The meeting was called to order by President Klein at 8:30 p.m. at the NASA Goddard Space Flight Center, Greenbelt, Md. General introductions were made by the 40 attendees. President Klein announced that the tentative launch date for AMSAT-OSCAR 7 is October 3, 1974.

V.P. Bill Tynan provided background information on the forthcoming Folk Festival on the Mall from 10-14 July. AMSAT is scheduled to be responsible for demonstrations on Friday, 12 July and Sunday, 14 July from 11 a.m. to 5 p.m. Assistance was solicited for this Festival as well as in several other fields involved in the administration of activities as large as the present day AMSAT organization.

V.P. Tynan advised the status of AMSAT nets and scheduled times for use. He also provided information on the local Washington AMSAT 2 meter repeater WR3ABU (146.25/146.85 MHz).

OSCAR 6 will be on for the ARRL Field Day tests, June 22 and 23 for as many orbits as possible (#7704-7708 and 7711-7714) subject to battery status. Efforts are underway to establish two command stations in Europe - one in Africa and one in England.

Executive V.P. Jan King gave an introduction on the background of OSCAR 7 and then gave an excellent slide presentation of its construction, integration and testing. He indicated a need for support to receive and tabulate the telemetry data in order to assist in the management of the satellite. OSCAR 7 will be in a telemetry mode for at least 24 hours after launch.

V.P. Tynan spoke about operational activity plans during the first 24 hours of OSCAR 7. He outlined the activities during the OSCAR 6 launch and the problem which occurred at that time. He hoped to avoid these problems with OSCAR 7.

President Klein informed the group that support is urgently needed for reception of teletype telemetry data. Al Whiting, K3BRS and Dick Daniels, WA4DGU indicated they would be willing to assist. Don Parris, W4NSP offered help on the teletype equipment. Help is needed to service various test equipments and communications equipment. A Newsletter editor will be needed in about six months, and Joe Kasser, G3ZCZ/W3 offered to help out with this task.

Recognition was given to the various individuals who have made a major contribution to OSCAR 7, particularly Dick Daniels, WA4DGU and Marie Marr, AMSAT's aerospace technician.

An invitation was extended to all for a visit to Jan King's basement laboratory to see OSCAR 7.

Charles Dorian, W3JPT
Secretary

AMSAT-OSCAR 7 BAND PLAN

by Bill Tynan, W3KMV

Several months ago Dick Smith, W1FTX made a suggestion that on the OSCAR 7 two-to-ten meter translator we attempt to set up a certain portion of the passband for CW and another portion for phone and other types of emission. In this way some of the QRM caused by the general incompatibility of different modes, which has been very prevalent on AMSAT-OSCAR 6, would be alleviated.

We have received a number of favorable comments on Dick's suggestion and practically no unfavorable ones. As one important sounding board, we put the question to those OSCAR users assembled at the ARRL National Convention held in New York City in July. This group endorsed the idea wholeheartedly, so we are going to officially propose it.

As everyone probably knows by now, in OSCAR 7 the downlink for the two-to-ten meter translator is 29.40 to 29.50 MHz, with the beacon at the high end on 29.50 MHz. The corresponding uplink is 145.85 to 145.95 MHz. What is proposed is to encourage CW stations to use the sub-band 29.445 to 29.495 MHz (5kHz is reserved for a guardband for the beacon) except when wishing to contact a specific phone station operating below 29.445. Phone stations and all other modes, such as SSTV and RTTY, are asked to stay below 29.455 MHz. Thus, the 10 kHz band 29.445 to 29.455 MHz will be sort of an "everyman's land." The reason that the high end, rather than the low end, was selected for CW as is usually the case on the HF bands, is that the beacon is on the high end in OSCAR 7 and it is felt that CW stations will pose less of a QRM threat to the beacon. Also, many people on CW on OSCAR 6 are crystal controlled, whereas almost everyone on phone (SSB) are VFO. Using the high part of the OSCAR 7 passband for CW will mean that many crystals useful for OSCAR 6 can also be employed when working through OSCAR 7.

We think that this plan is worth trying and hope that all OSCAR 7 users will get behind it and make it work. Those not adhering to it should be gently reminded.

AMSAT-OSCAR 7 LAUNCH NETS

by Bill Tynan, W3KMV

Those who were around for the launch of AMSAT-OSCAR 6 may remember the nets which were set up in order to attempt to keep the amateurs of the world informed as to progress. For the launch of AMSAT-OSCAR 7, a similar group of nets will be set up. Some things are different now than two years ago. For one thing, ten meters cannot be counted upon for reliable wide range coverage at this portion of the sunspot cycle so there is no need to employ that band this time. Also, there should be more knowledge on the part of many amateurs so there should be less need to cover a large number of frequencies.

With these considerations in mind, here is the plan which has been established for keeping everyone up to date on the launch of AMSAT-OSCAR 7.

Starting four days before launch, regular bulletins will be aired on the normal AMSAT frequencies of 3850 kHz LSB and 14280 USB. The 75 meter bulletins will be sent at 0100Z each day, and the 20 meter ones at 1800Z. This schedule will continue for several days after launch in order to provide orbital data and receive telemetry reports.

On launch day, a continuous schedule of transmitting and listening will be maintained beginning at the time of launch on the following frequencies:

3850 kHz LSB
7280 kHz LSB
14280 kHz USB toward Europe
21280 kHz USB toward South America.

The pre-launch countdown will be transmitted by W6AB, the club station at Vandenberg Air Force Base, on 14240 kHz USB. These transmissions will be relayed through the AMSAT repeater in the Washington area (WR3ABU 146.25 MHz in, 146.85 MHz out). Various stations in the Washington area will then relay these transmissions on the above HF frequencies. Such relaying from one band to another will require special FCC approval under the rules adopted in Docket 18803, and appropriate authority is being requested.

After launch, information available from Washington will be fed to the network. Following ejection of AMSAT-OSCAR 7 from its Thor-Delta launch vehicle, the network will stand by for stations with early telemetry data. It is particularly important that we receive the data as soon as possible. As stated in the OSCAR 7 Operations Plan published elsewhere in this issue, OSCAR 7 will not be turned on for regular two-way communications for at least 24 hours after ejection in order to ensure that we know how the satellite is operating before putting it into service. So consider this a plea for rapid telemetry data on launch day and for a few days thereafter.

Of course, in addition to the above AMSAT nets, up to date information can also be obtained by copying the regular W1AW bulletins and additional transmissions which W1AW will carry during launch.

K2RIW 432 MHz AMPLIFIER FOR AMSAT-OSCAR 7

The K2RIW 432 MHz amplifier described in QST for April and May, 1972 and the ARRL VHF Handbook is a practical answer to the need for higher power levels to access the AMSAT-OSCAR 7 432/144 MHz repeater.

All parts for this amplifier, some of which have been hard to obtain, are being made available by W2GN. W2GN is also in a position to supply a limited number of custom built units ready to operate, complete with blower and power supply if desired. Write to Fred Merry, W2GN, P. O. Box 546, East Greenbush, N.Y. 12061, for parts lists and information.

The W2GN version has the following variations from the original article:

AB1 operation is used with filament, bias and screen supplies self-contained on a larger bottom chassis. Anode current is read from a 10 ohm resistor in the negative lead, and high voltage is read from a 5 megohm multiplier, thus providing full metering on a six-position switch.

On the mechanical side, screws are used to secure the top plate and three chassis, and also for compression fasteners for the screened vents. Planetary dials drive the tuning capacitors. At the suggestion of K2RIW, the lip of the plate tuning capacitor was tinned to remove the possible long term effect of dissimilar/metal contact at this point.

W2GN's experience in building several of these amplifiers has further proven the soundness of K2RIW's design. Follow the instruction in K2RIW's article carefully. You will have a stable and powerful amplifier with low drive requirement which seems to be just the ticket for up-linking to OSCAR 7.

WASHINGTON SATELLITE COMMUNICATORS AWARD

Concerning the Washington Satellite Communicators award for OSCAR 6, we will have a new certificate for OSCAR 7 with the same requirements. There is a change of address for the award. The new address is:

Tim Blair - WA7FVT
P. O. Box 2262
Tacoma, Washington 98401

ANNOUNCEMENT OF AMSAT ANNUAL MEETING

The sixth AMSAT Annual Meeting will be held at 8:00 p.m. on Saturday, November 9, 1974, at the Building 3 Auditorium at the NASA Goddard Space Flight Center in Greenbelt, Maryland.

In accordance with the AMSAT Bylaws, ballots for the election of three Directors and two alternate Directors will be counted at this meeting. The terms of the following Directors will be expiring as of this meeting: William Dunkerley, WA2INB; William Hook, W3QBC; and Raphael Soifer, K2QBW.

The agenda, in addition to the election and regular business, will include:

AMSAT Annual Report
AMSAT-OSCAR 7 Progress Report
AMSAT-OSCAR 6 Progress Report
Results of election of Directors.

For those coming from out of town, let us know, and we will arrange for you to be hosted by Washington area AMSAT members.

Directions to the NASA Goddard Space Flight Center:

Take the Baltimore-Washington Parkway to the Greenbelt Road exit (Rt. 193), and take Greenbelt Road east 1.3 miles to the Goddard gate (on the left). Tell the guard you are there for the "amateur radio" meeting.

There will be an informal AMSAT dinner before the meeting at 5:30 p.m. at Emersons Restaurant on Rt. 193 (Greenbelt Rd.) at the Beltway Plaza Shopping Center, located 3 miles west of the Goddard Space Flight Center (1.7 miles west of the Baltimore-Washington Parkway). Please let us know if you can join us so that we can firm up reservations.

The 146.25/85 AMSAT repeater will be available for talk-in before the dinner and the meeting.

AMSAT-OSCAR 7 PHOTOGRAPHS AVAILABLE

AMSAT has a number of photographs of the AMSAT-OSCAR 7 spacecraft in various stages of construction and testing. We will be happy to send out these photos to anyone who can make good use of them for publicity and publication purposes.

1974 CANDIDATES TO THE AMSAT BOARD OF DIRECTORS

Robert J. Carpenter, W3OTC

Bob Carpenter, W3OTC, is an Electronic Engineer at the National Bureau of Standards in Gaithersburg, Md., where he designs digital and analog electronic circuits. He is past president of the Rock Creek Amateur Radio Association and has also been Vice President of the National Capital VHF Society. He is a life member of AMSAT, and for the past year has been an alternate director. He has built his own minicomputer and has developed a computer program to reduce AMSAT-OSCAR 6 telemetry data. He has been active on the AMSAT 146.25/85 repeater (WR3ABU), and designed and constructed the control circuitry for the repeater and rewired some of the RF circuits. He has also assisted in troubleshooting some of the command and experiment control logic circuits in AMSAT-OSCAR-B.

Dr. Thomas A. Clark, WA3LND/W0IUF

Tom Clark, WA3LND/W0IUF, is a Radio Astronomer at the NASA Goddard Space Flight Center in Greenbelt, Md., where he heads an effort in very long baseline interferometry, a technique used to study Quasars and other celestial objects. First licensed in 1952, he is a charter member of the Goddard Amateur Radio Club and a past president of the University of Colorado and Boulder Amateur Radio Clubs. He was net control station of the Colorado Emergency Phone Net and High Noon Net, and is currently a control station for the Maryland FM Association's repeater. From 1960-1966, he was very active in VHF propagation research using meteor scatter, aurora, tropo-scatter and ionospheric scatter. He was involved with OSCAR's 1 and 3. He is an active user of AMSAT-OSCAR 6 and has qualified for the Satellite 1000 and 10 Call Districts awards. He is also active on the AMSAT 146.25/85 repeater. For the past year, he has been providing advisor and NASA liaison functions for AMSAT. A life member of AMSAT, he has also developed an antenna pointing computer program for tracking OSCAR orbits, and helped arrange test equipment and calibrate the telemetry sensors during AMSAT-OSCAR-B testing.

William I. Dunkerley, Jr., WA2INB

William Dunkerley, WA2INB, is Managing Editor of QST at ARRL Headquarters, Newington, Connecticut. He was chairman for the International VHF Convention held in 1964, and was a founder of the Space Communications Group of the East Coast VHF Society, where he was Vice President. He is a past assistant director of the ARRL Hudson Division. He is a director of the Talcott Mountain UHF Society and has been active in their work with OSCAR 5 and OSCAR 6. He is a member of the Scientific Advisory Council of the Talcott Mountain Science Center. A life member of AMSAT, he has been an AMSAT director since 1969, and has been serving as AMSAT's ARRL coordinator. As such, he has handled AMSAT material appearing in QST and in ARRL bulletins, and he has personally authored numerous articles on OSCAR 5 and OSCAR 6 in QST. He coordinated preparation of OSCAR school curriculum material and is actively involved in the educational and training programs for OSCAR 6 and 7.

Lawrence S. Kayser, VE3QB/VE3RMR

Larry Kayser, VE3QB/VE3RMR, is with the Department of Supply and Services in Ottawa, Ontario, where he is responsible for the procurement of communications and electronic data processing equipment for the Canadian government. Licensed since 1954, he is trustee and builder/operator of VE3TEN, an ARRL/IARU ten-meter propagation beacon station. For the past year and a half, he has served as a primary AMSAT-OSCAR 6 telecommand station and has developed a sophisticated automated OSCAR telecommand terminal, a project which brought him the 1973 ARRL Technical Merit Award. He led the Canadian AMSAT team that built the 435.1 MHz beacon for AMSAT-OSCAR-B, and is involved in a Canadian group effort to construct flight hardware for future OSCAR satellites. He is a life member of AMSAT.

Gary L. Tater, W3HUC

Gary Tater, W3HUC, is with the Department of Defense in the Washington, D.C. area and is involved with the design of high reliability space communications systems. He was first licensed as K1YLU in 1962 and is past president of the Montachusett Amateur Radio Club. He holds an Advanced Class license and has been active in VHF contests, operating on six and two-meter SSB and 432 MHz CW. An author of several articles on OSCAR satellite operation, he is an active user of AMSAT-OSCAR 6 (as K1YLU/3 and W3HUC), and assisted with AMSAT's OSCAR 6 demonstrations at the Smithsonian Festival of American Folklife.

Richard Zwirko, K1HTV

Rich Zwirko, K1HTV, is a broadcast technician at WTIC-AM/FM in Hartford, Conn. Licensed since 1958, he is past president of the Connecticut Wireless Association and is a very active user of AMSAT-OSCAR 6 as well as being active with meteor scatter and VHF/UHF DXing. He has been an official AMSAT bulletin station for over a year, and also relays traffic regularly via OSCAR 6 into the ARRL National Traffic System. He also has served as an OSCAR 6 telecommand station operator during the months that the Talcott Mountain UHF society's telecommand station was in operation.

BE SURE TO VOTE. SEND IN THE MAIL BALLOT
ON THE NEXT PAGE.

AMSAT-OSCAR 6 SATELLITE PINS

AMSAT-OSCAR 6 satellite pins are now available to all AMSAT Life Members. These pins have been provided courtesy of Steve Hay, K5RZU, and the Hesse Envelope Company of Dallas, Texas.

Thinking of Life Membership? Send in a contribution of $50 or more and receive your AMSAT-OSCAR 6 satellite pin with your life membership certificate.

AMSAT
Radio Amateur Satellite Corporation
P.O. BOX 27, WASHINGTON, D.C. 20044

This is your official ballot for the election of directors for 1974-1976. In accordance with Article IV, Section 2 of the Bylaws, three (3) Directors are to be elected in even numbered years. In accordance with Article V, Section 2, the nominations of candidates on the ballot below have been submitted to the Secretary by an Authorized Officer of a Member Society.

Ballots will be counted at the Annual Meeting, Saturday, November 9, 1974, by tellers appointed by the President.

PLEASE VOTE

Please fill in the ballot below -- now -- and mail it today. (If you would prefer not to tear it out of your Newsletter, write your choices on a blank slip of paper.) Place your ballot in a plain envelope and mail it in a second envelope which has your name and membership number on the outside. This information is needed to validate your ballot.

BALLOT

Select three (3) from the following list of nominations:

Name	Call	Address
☐ Robert J. Carpenter	W3OTC	Rockville, Md.
☐ Thomas A. Clark	WA3LND	Laurel, Md.
☐ William I. Dunkerley, Jr.	WA2INB	Newington, Conn.
☐ Lawrence S. Kayser	VE3QB	Ottawa, Ontario, Canada
☐ Gary L. Tater	W3HUC	Ellicott City, Md.
☐ Richard Zwirko	K1HTV	Meriden, Conn.

Mail to AMSAT, P. O. Box 27, Washington, D.C. 20044, USA, to reach us by November 9, 1974.

AMSAT GRATEFULLY ACKNOWLEDGES DONATIONS OF $50.00 OR MORE FROM THE FOLLOWING SUPPORTERS WHO HAVE RECENTLY BECOME LIFE MEMBERS

LM-65	Herbert Hoover, III	W6APW	San Marino, California
LM-66	M. J. Bullough	VE8YI	Winnipeg, Manitoba, Canada
LM-67	Leigh Bassett	WA3PQV	Glen Burnie, Maryland
LM-68	Jerry S. Stover	W5AE	Dallas, Texas
LM-69	S. E. Haag	W4MOP	Jeffersontown, Kentucky
LM-70	Ralph McIntyre	W8WOM	Akron, Ohio
LM-71	James S. Eden	K8UIW	Cuyahoga Falls, Ohio
LM-72	W. H. Jarvis	GM8APX	Perthshire, Scotland
LM-73	Thomas Pappan	WA8ZTY	Owosso, Michigan
LM-74	Ellis R. Romer	W7LFX	Tucson, Arizona
LM-75	Paul Swedberg		FPO New York, New York
LM-76	Robert Wilcox	K8OMS	Owosso, Michigan
LM-77	Edgar de Jesus	DU1EJ	Manila, Philippines
LM-78	Roy Alton Simpson	WA5TJB	Russellville, Arkansas
LM-79	John M. Henry	VE2DNM	Aylmer, Quebec, Canada
LM-80	Gary C. Anderson	W2UCZ	Jamestown, New York
LM-81	Viola H. Chambers	W6NTC	Palos Verdes Estates, Calif.
LM-82	David L. Suchodolski	WA4SNY	Lynchburg, Virginia
LM-83	Rudolfo Rulloda	KX6RR/KH6IHO	Wahiawa, Hawaii
LM-84	Dr. Thomas A. Clark	WA3LND/W0IUF	Laurel, Maryland
LM-85	Dr. Norman L. Chalfin	K6PGX	Pasadena, California
LM-86	Donald S. Parris	W4NSP	Arlington, Virginia
LM-87	Wayne D. Myers	WB9OLJ	Chicago, Illinois

LMS-4	Dallas Amateur Radio Club	Dallas Texas
LMS-5	Radio Society of Great Britain	London, England
LMS-6	Central States VHF Society	Boulder, Colorado

Interested in becoming a Life Member? Life Memberships are available for a donation of $50 or more ($100 or more for Life Member Societies).

MEMBERSHIP RENEWAL NOTICE

AMSAT has changed to an end-of-year billing for renewals. All memberships will expire at the end of a calendar year. This simpler procedure is followed by many societies like AMSAT whose membership records are kept by a volunteer staff.

A renewal envelope is included in this Newsletter for renewal of your membership. Please check your mailing label for accuracy and to determine the amount to remit. Explanation of the top line of label:

Expiration Date	Coding (See form below)	Member No.
10-74	ACEGH	123

A - Hold an amateur license.
B - Do not hold a license.
C - Member of the ARRL.
D - Non-member of ARRL.
E - Will participate actively in AMSAT activities.
F - Do not desire to actively participate.
G - Capabilities lie in technical areas.
H - Capabilities lie in administrative areas.

Renewal Payment Table

Month Membership Expires (from Label)	Pay This to Renew Through 1975	Pay This to Renew Through 1976
06-74	$ 7.50	$ 12.50
08-74	6.67	11.67
10-74	5.83	10.83
12-74	5.00	10.00
02-75	4.17	9.17
04-75	3.33	8.33
06-75	2.50	7.50
08-75	1.67	6.67
10-75	0.83	5.83
12-75	0	5.00

For dates earlier or later than those shown in the above table, you may extrapolate from the table. Renewing members will receive an AMSAT membership card showing their new expiration date. Note, if you have renewed recently, your label may not yet reflect the change. Member Societies please note that dues for affiliated clubs are $10.00 per year -- so multiply the amounts in the table above by two.

LIFE MEMBERSHIPS

The AMSAT Board of Directors has approved the granting of Life Memberships to those individuals contributing $50.00 or more and to societies donating $100.00 and upward. Life Members will be assigned a new Life Member number and will receive a membership certificate and card indicating their new status as well as an OSCAR 6 satellite pin. Application may be made using the renewal envelope enclosed in this issue.

AMATEUR SATELLITE MATCHING FUNDS

William W. Eitel, WA7LRU/W6UF and Herbert Hoover, III, W6APW have generously offered to match, dollar-for-dollar up to a total of $25,000, donations to the ARRL Foundation earmarked for the amateur satellite program. To date, about $15,000 have been received.

Additional funds are urgently needed to support the construction of AMSAT-OSCAR 8, which is estimated will cost on the order of $100,000.

We urge you to support the amateur satellite program with a financial contribution. Please return the form below to the ARRL Foundation with your donation right away. Contributions to the ARRL Foundation are tax-deductible under Section 170 of the Internal Revenue Code.

Thank you for your support!

TO: The ARRL Foundation, Inc.
225 Main Street
Newington, Connecticut 06111

Date: ____________________

Gentlemen:

Enclosed is my contribution of _______________ which I wish to designate for AMSAT's amateur satellite program, as part of the Eitel-Hoover matching fund offer.

Name: _____________________ Call: ________
Address: ______________________________
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AMSAT
Radio Amateur Satellite Corporation
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(202)488-8649

AMSAT-OSCAR 7 TECHNICAL OPERATIONS PLAN AND EXPERIMENTER'S GUIDE

PREFACE

This document has been prepared to outline for the telecommand stations and user experimenters, the expected conditions under which the several experiments onboard AMSAT-OSCAR 7 are to be used. (NOTE: For all purposes of publication or correspondence, please be sure to refer to the satellite as "AMSAT-OSCAR 7.")

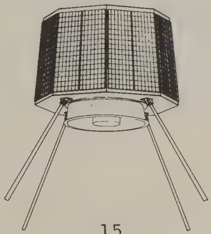
1.0 MISSION OBJECTIVES

The principal objective of the AMSAT-OSCAR 7 mission is to provide a means for its use as an educational tool in schools. Other objectives include the demonstration, by means of stations in the amateur service, of the feasibility of using satellites with small user terminals for "bush" communication, emergency communication, communication between medical centers and isolated areas, aeronautical, maritime and land mobile communications, direct satellite-to-home voice broadcasting to simple amateur receivers and other similar applications. Further objectives are to demonstrate special operating techniques that enhance the usefulness of low orbits for these satellite applications, and to test new communications repeaters and telemetry systems for operation with small terminal users.

1.1 OSCAR Education Program

A fundamental objective of the AMSAT-OSCAR 7 mission is to permit continuation of the education program begun with OSCAR 5 and 6 over a longer-term basis consistent with its longer three-year anticipated lifetime. OSCAR satellites are beginning to play an important role in a new approach to science education. Used as remote laboratory tools, these satellites represent a pioneering utilization of an active space system in the classroom. Since the launch of the first satellites seventeen years ago, satellites have had a very dramatic impact on American education. With inexpensive ground terminals for OSCAR satellites in schools, students can gain first-hand experience in space science. This type of direct, active involvement has relevance to the study of communications, astronomy, physics, mathematics and meteorology. The OSCAR ground terminal puts at the disposal of the instructor and student, an active satellite system, for demonstration and experimentation.

With the assistance of the American Radio Relay League, the organization responsible for OSCAR satellite educational activities, OSCAR curriculum material has been prepared under a contract with the Talcott Mountain Science Center, Avon, Connecticut, and is being distributed to schools throughout the country. Technical and educational consultation services are also being provided at no cost to encourage teachers to establish OSCAR ground terminals in their classrooms.



1.2 Small-terminal "Bush" Communication Tests

"Bush" or "out-back" communication of a non-amateur variety such as might be found in Alaska, northern Canada, Australia, Antarctica or the developing countries is analogous in many respects to amateur communication anywhere in the world. Many amateurs regularly use small portable HF and VHF transmitters and receivers, equipment installed in automobiles, and hand-held equipment. AMSAT-OSCAR 7 is designed to provide long-distance VHF communication, especially needed during night-time periods or during other times when long-distance ionospheric communication at HF is difficult. Amateurs equipped in various localities, including particularly Alaska and Antarctica will be called upon to participate in these tests.

1.3 Emergency Communication

Radio amateurs have, on numerous occasions, provided the only source of communication in time of emergency. The 1970 earthquake in Peru and 1972 earthquake in Managua are but two recent examples. Indeed, in setting forth the basis and purpose of the amateur service, the U. S. Federal Communications Commission cites ". . . the value of the amateur service to the public as a voluntary noncommercial communication service, particularly with respect to providing emergency communications." It is expected that AMSAT-OSCAR 7 will be used in support of such communications during any such emergencies, as a backup for HF radio, which is highly dependent upon favorable ionospheric conditions.

1.4 Medical Data Communications

Many cases have been documented in which amateur communication was used to locate needed drugs, diagnose a rare disease or give medical instructions during surgery. AMSAT-OSCAR 7 will be capable of relaying such communication and, in addition, tests will be arranged between medical centers and hospitals in isolated areas to exchange medical data using the satellite to relay this information. The National Institutes of Health Amateur Radio Club in Bethesda, Maryland, an AMSAT affiliated organization, has been involved in this aspect of the amateur satellite program.

1.5 Mobile Terminal Communication

AMSAT-OSCAR 7 is the first amateur satellite to employ circularly polarized antennas so that the spacecraft can potentially provide further useful data on satellite signal propagation to mobile terminals, supplementing the multipath and ionospheric scintillation data already obtained at VHF from NASA's ATS-1 and ATS-3 Applications Technology Satellites, which used linearly polarized antennas. Aircraft, ship and automobile amateur terminals will be installed to provide further information on the feasibility of using VHF satellite mobile terminals over all possible satellite elevation angles and with several types of modulation.

1.6 Direct Satellite-to-Home Voice Broadcasts

The transmitter power output of AMSAT-OSCAR 7 is expected to be sufficient to permit useful reception with ordinary amateur receivers using low-gain receiving antennas. Transmissions using the satellite repeaters will demonstrate the potential of using satellites for satellite-to-home voice broadcasting directly to conventional, inexpensive receivers. In addition, it is anticipated that satellite experience will lead to the development by amateurs of increasingly simple ground equipment for these applications. Amateurs have a history for devising innovative methods of producing simple equipment at low cost.

1.7 Low-Orbit Operational Feasibility

AMSAT-OSCAR 7 is intended for operation in a 1460 Km orbit, considerably below synchronous altitude. AMSAT expects to be able to demonstrate the operational potential of such low, non-synchronous polar orbits for the small terminal user applications outlined above.

1.8 Communication Repeater and Telemetry Experiments

Two types of experimental communication repeater systems, two experimental telemetry systems and a store-and-forward message storage unit are flying on this mission. These include experiments designed and constructed in Australia, Canada, Germany and the United States. The unique characteristics of these experiments are described in Section 2.

2.0 SPACECRAFT DESCRIPTION

AMSAT-OSCAR 7 is a small communications satellite designed to operate with small stations in the amateur service on a non-commercial basis. The spacecraft contains two basic experimental repeater packages, redundant command systems, two experimental telemetry systems, and a store-and-forward message storage unit. The spacecraft is solar powered, weighs 65 pounds, and has a three-year anticipated lifetime. It contains beacons on 29.50, 145.98, 435.10 and 2304.1 MHz.

2.1 Communications Repeaters

Two types of communications repeaters are aboard the spacecraft, only one of which operates at a time. The first repeater is a higher power, two-watt version of the one-watt two-to-ten meter linear repeater that flew on the OSCAR 6 mission. This unit receives uplink signals between 145.85 and 145.95 MHz, and retransmits them between 29.4 and 29.5 MHz on the downlink. A 200 milliwatt telemetry beacon provides telemetry data on 29.502 MHz.* Approximately -100 dBm is required at the repeater input terminals for an output of 1 watt. This corresponds to an eirp from the ground of 80 watts for a distance to the satellite of 2,000 miles and a polarization mismatch of 3 dB.

The second repeater, constructed by AMSAT Deutschland e.V., AMSAT's affiliate in Marbach, West Germany, is a 40-kHz* bandwidth linear repeater. It employs an 8 -watt* PEP power amplifier using the envelope elimination and restoration technique to maintain linear operation over a wide dynamic range with high efficiency. This repeater has an uplink from 432.125 to 432.175 MHz, and a downlink from 145.925 to 145.975 MHz. Since the uplink band is shared with the radiolocation service, an experimental pulse suppression circuit is incorporated in the repeater to reduce the effects of wideband pulsed radar interference in the uplink. Developmental versions of this repeater have flown in high-altitude balloon experiments in Germany, and aircraft flight tests of the repeater prototype unit. A 200 milliwatt telemetry beacon on 145.975* provides telemetry data. Approximately 80 W.*eirp is required to produce 3 watts of repeater output at a range of 2,000 miles assuming a polarization mismatch of 3 dB.

The two repeaters are operated alternately by means of a timer arrangement, but repeater selection and output power control can also be accomplished by ground command. Each of the repeaters includes a keyed telemetry beacon at the upper edge of the downlink passband to provide housekeeping data and to provide a frequency and amplitude reference marker to assist the amateur in antenna pointing, Doppler frequency compensation, and setting uplink power level. The cross-band (146-to-29.5 and 432-to-146 MHz) design of the two repeaters will permit the amateur to monitor his own downlink signal easily, and consequently, he can adjust his power and frequency to continually compensate for changing path loss, repeater loading and Doppler shift. It is anticipated that such a method of self-monitoring and control can eventually be made automatic through closed-loop frequency and power control circuitry that can be developed for the ground terminal equipment. Both repeaters are designed for use by as many as one to two dozen single-sideband amateur stations, all transmitting simultaneously, where downlink self-monitoring will minimize interference between users and will also permit duplex operation as well as self-control of power balance.

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*This number represents a more precise actual measurement which differs from previously reported values.

2.2 Command System

Redundant command decoders of a design similar to the unit proven highly successful in OSCAR 6 will be flown. The decoder has provisions for 35 separate functions, and is designed to provide a reliable means of controlling the emissions of the repeaters, beacons and other experiments aboard the spacecraft.

2.3 Telemetry and Message Storage Systems

AMSAT-OSCAR 7 contains two experimental telemetry systems designed for use with simple ground terminal equipment. The first system, developed by the WIA-Project Australis group in Australia, telemeters 60 parameters in 850-Hz shift, 60 WPM five-level Baudot teletype code to permit printout on standard teletype equipment in a format readily convertible for direct processing by small digital computer. The second system telemeters 24 parameters as numbers in standard Morse code and can be received with pencil and paper. This system was used on OSCAR 6 and proved highly successful as a reliable means of obtaining real-time telemetry data.

An experimental Morse code message storage unit, Codestore, capable of storing and repeatedly retransmitting 18-word Morse code messages loaded by ground stations is also aboard AMSAT-OSCAR 7. This unit was first flown on OSCAR 6.

The teletype telemetry encoder amplitude-modulates telemetry beacons on 29.50 MHz (200 mw), 145.98 MHz (200 mw) and frequency-shift keys the beacon on 435.10 MHz (300-400 mw), as selected by ground command. The Morse code telemetry encoder and Codestore message storage unit directly key these beacons as selected by ground command.

3.0 LAUNCH INTERFACE AND ORBIT

The AMSAT-OSCAR 7 spacecraft is being launched from the NASA Western Test Range as a secondary "piggyback" payload with the ITOS-G meteorological satellite and the Spanish INTASAT spacecraft. The spacecraft will be ejected from the second stage of the two-stage Thor-Delta launch vehicle 4,653 seconds after lift-off, at a position of 38.4°N. latitude, 23.5°E. longitude. Orbital parameters are expected to be very similar to those of AMSAT-OSCAR 6: 1,460 km altitude circular orbit, 102° inclination (retrograde, sun-synchronous orbit).

Four seconds after ejection from the launch vehicle, two sets of pyrotechnic nylon line cutters will fire, deploying the ten-meter dipole antenna, and one to two seconds later the spacecraft will initialize in Mode D*, the recharge mode, with all transmitters OFF except the 435.1 MHz telemetry beacon.

4.0 SPACECRAFT INITIALIZATION PROCEDURE

AMSAT-OSCAR 7 will automatically be powered up upon ejection from the Thor-Delta launch vehicle in the vicinity of Italy and Greece, and is designed to initialize itself in Mode D with the 435.1 MHz beacon ON, keyed with Morse code telemetry at 20 or 10 WPM. Unless overridden by ground command, after 24 hours the spacecraft clock will switch the satellite to Mode B*. It was found during thermal-vacuum tests that the 70 cm-to-2 m repeater can develop corona discharge in the RF power stages during the pressure transition to vacuum. Therefore, to prevent possible damage to this repeater, the satellite should be commanded to Mode A 24 hours after initialization to give an additional 24 hours for the 70 cm-to-2 m repeater to outgas to the pressure of hard vacuum where corona will no longer be present.

On the second day, after A-O 7 is in orbit, each telecommand station should verify that it is able to command successfully by switching the code speed on the 435 MHz beacon, first using command decoder "A" and then "B", and using command receiver channel A (which operates in Mode D as well as in Mode A).

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* See Section 5 for a description of the operating modes.

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Please attach your mailing label here (or copy the information in the space provided.)

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G CAPABILITIES LIE IN TECHNICAL AREAS.
H CAPABILITIES LIE IN ADMINISTRATIVE AREAS.

AMSAT

Dear AMSAT Member:

Your present membership in AMSAT will expire December 31 of the year shown on your mailing label. We have valued your support highly and would like to see it continued. Please forward $5 renewal dues ($7 family, $10 club) in this envelope and update your address and coding. $3 per year of your dues cover your subscription to the quarterly AMSAT Newsletter. For convenience, we encourage you to prepay your dues for any number of years, and life membership is available for a donation above $50. Please attach your mailing label, noting any corrections, and circle the appropriate letters below.

73,

William Hook, W3QBC
Treasurer

The spacecraft 24-hour clock should be reset as close to 0000 GMT as possible on the day of launch, and again on the day following launch (before the spacecraft has a chance to go into Mode B). As soon as possible after launch, the teletype telemetry encoder should be commanded by the Australian command station alternately between the "dwell" and "run" modes several times. This will initialize the teletype telemetry system, and with it, its clock (which is read out in octal form as part of the teletype telemetry status information). The teletype encoder will not operate until it is initialized, so its operation is a ready means of identifying that the unit has been initialized properly.

On the first orbit following the reference orbit during the initial days when the satellite is still in Mode D, teletype telemetry should be commanded onto the 435 MHz beacon so that data can be collected from this system and its proper operation can be verified. On other orbits, the 435 MHz beacon should be keyed with Morse code telemetry until the satellite is declared operational and is put into its regular daily Mode A - Mode B operating cycle.

Once operationally in Mode A, the two-to-ten meter repeater should automatically have been initialized to operate at full sensitivity and with the 29.50 MHz beacon keyed with 20 WPM Morse code telemetry. If any of these conditions are not found to be the case, the spacecraft should be manually commanded to these modes. The 435 MHz beacon should be commanded over to teletype telemetry and left ON, the normal operational conditions for Mode A (as described in Section 5.1).

When the spacecraft first goes operationally into Mode B, each telecommand station should verify that it is able to command successfully by commanding the Morse code telemetry to key the 145.98 MHz beacon (if not already initialized in this condition), and switching the code speed, using command receiver channel B (which operates in Mode C as well as in Mode B).

The Morse code telemetry should be carefully recorded in the initial orbits. First the voltages should be verified (channels 3A, 3B, 3C), as well as the charging currents in sunlight (1A = 1B + 1C + 1D + 2A, although spacecraft spin may affect this result). 2D should be greater than 50 counts when the spacecraft is in sunlight. Verify that calibration channel 6D = 50 ± 1 counts; if it is not, all other data telemetered by the Morse code telemetry encoder may be invalid. Proper operation of the 24-hour clock can be checked by observing channel 2C, and this is the normal means of telling when the clock is about to switch from Mode A to Mode B or vice versa. (When channel 2C = 92 counts, switching of modes can be expected within 14.4 minutes.) Successful resetting of the clock on ground command can be verified by observing if 2C = 0. 2C should begin at 0 and increment one or two counts each 14.4 minutes.

As the several beacons and two repeaters become powered up for the first time, their respective RF power outputs should be verified (channels 6B, 6C, 6A and 2B), and their power consumption should be verified from channels 5B and 2D. Channel 2D should provide a useful means of measuring instantaneous power consumption of the systems in operation at any given time, but these measurements should be made while the satellite is in darkness so that charging current will be absent.

The temperature channels 3D, 4A, 4B, 4C, 4D, 5A and 5C should all read around room temperature (50 counts), although 5A and 5C will generally display higher temperatures (a lower number of counts) when the Mode B repeater is ON, and 4B will show higher temperatures when the Mode A repeater is ON.

5.0 SPACECRAFT OPERATING MODES AND FAILURE CONDITIONS

5.1 Mode A -- Two-to-ten Meter Repeater ON, 435 and 2304 MHz Beacons Operable

The two-to-ten meter repeater is always ON in Mode A, and only in Mode A. The 435.1 MHz beacon can be ON or OFF in this mode (by ground command), and normally will be ON and transmitting 850-Hz FSK teletype telemetry. The

2304.1 MHz beacon will normally be OFF except for specially scheduled experiments,* when it can be operated for 14 minutes at a time, after which it will be shut OFF by an internal timer. Keying of the 2304 MHz beacon is 170 Hz shift (F-1) Morse code.

The 29.50 MHz beacon is also always ON in Mode A, and normally will be sending Morse code telemetry at 20 WPM, except during orbits when Codestore contains a message to be read out periodically.

Mode A will be the normal operating mode on alternate days (GMT days) for 24 hours at a time, after which the OSCAR 7 onboard 24-hour clock will reset the spacecraft (at 0000 GMT)** to Mode B.

5.1.1 Mode A Failure Conditions

i) If there is a failure of the two-to-ten meter repeater, the satellite is to be commanded into Mode B and the spacecraft 24-hour clock should be reset by ground command every 24 hours (or less) to keep the spacecraft in Mode B. Remember that if there is a loss of the two-to-ten meter repeater receiver or of command channel A, all commanding must be done while the spacecraft is in Mode B or C (using command channel B). If the clock should put the spacecraft in Mode A before it is reset from the ground, command capability will be lost for 24 hours until the clock again switches the satellite back from Mode A to Mode B. Remember also that if the spacecraft should go into Mode D (either on command or due to a low-battery voltage condition sensed by the experiment control logic), again command capability will be lost until the clock switches the spacecraft from Mode D into Mode B 24 hours later.

ii) In the event of loss of the 435 MHz beacon, this beacon should be kept OFF except for periodic tests to see if the unit has recovered. The teletype telemetry is then to be switched to the 145.98 MHz beacon (in AFSK mode) between 1200 and 2400 GMT on Mode B or C days, and Morse code telemetry on the 145.98 MHz beacon at other times. On Mode A days, the 29.50 MHz beacon should be commanded back to Morse code telemetry at approximately 0000 GMT.

iii) The 2304.1 MHz beacon should normally be kept OFF until such time as Government authorization is received to conduct experiments in this band. When authorization is approved, the beacon will generally be operated in the "internal" (long carrier) mode, unless there is a failure of the 435.1 or 29.50 MHz beacon, in which case it is to be switched to the Morse code telemetry mode and activated more frequently. If the 2304.1 MHz beacon should fail, this beacon should not be turned ON except for periodic tests to see if the unit has recovered.

5.2 Mode B -- 70 cm-to-2 m Repeater ON in High-power Mode, 2304 MHz Beacon Operable

The seventy centimeter-to-two meter repeater is always ON in Mode B in the full-power (10 watt) mode, and the 145.98 MHz beacon always operates in this mode. The 2304.1 MHz beacon can be operated upon ground command in this mode.

Mode B will be the normal operating mode on alternate days (GMT days) for 24 hours at a time, after which the onboard 24-hour clock will reset the spacecraft (at 0000 GMT) to Mode A.

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*The U. S. Federal Communications Commission has notified AMSAT that the 2304 MHz beacon should be "prevented from transmitting" until further notice.

**The telecommand stations are asked to reset the spacecraft clock at 0000 GMT if the clock is more than five minutes off. If the clock is running slow, be sure to command also to the proper new mode.

5.2.1 Mode B Failure Conditions

i) If the 70 cm-to-2 m repeater receiver should fail, command capability in Mode B will be lost. When the 24-hour clock switches the spacecraft into Mode A, it should be reset by ground command every 24 hours (or less) to keep the spacecraft in Mode A. Remember that any commanding or clock-switching into Mode B will result in loss of command capability for 24 hours, when the satellite will again be switched by the clock into Mode A.

ii) If the 70 cm-to-2 m repeater transmitter should fail, command capability will still be possible in Mode B, but the satellite should be kept in Mode A and the clock reset every 24 hours (or less).

iii) If the 2304.1 MHz beacon should fail it should be kept OFF.

5.3 Mode C -- 70 cm-to-2 m Repeater ON in Quarter-power Mode, 2304 MHz Beacon Operable

In Mode B, the seventy centimeter-to-two meter repeater is always ON, but in the quarter-power (2.5 watt) mode. The 145.98 MHz beacon will be ON in this mode and the 2304 MHz beacon can be operated upon ground command. Normally, the spacecraft should be commanded to Mode C only if there is low battery voltage (between 12.1 and 12.4 volts, generally indicating a low battery charge condition). In this case the 2304 MHz beacon should not be turned ON so that it will not add to the battery drain.

5.3.1 Mode C Failure Conditions

i) Generally, Mode C is to be used if the battery is not charging sufficiently. Mode C can only be switched into by ground command, and should be selected if the battery voltage goes below a preset cutoff level of 12.4 volts. If there is a failure of one or more of the cells in the ten-cell battery, or if there are heavy current surges, this cutoff level may be reached while the overall battery is at a good level of charge.

ii) If any of the other failure conditions described in Section 5.2.1 should occur, the same command procedures outlined in that section should be followed.

5.4 Mode D -- Recharge Mode, Both Repeaters OFF, 435 and 2304 MHz Beacons Operable

In Mode D, both repeaters are OFF and telemetry can be obtained by commanding ON either the 435.1 or 2304.1 MHz beacon(s). Mode D should normally be used if recharging of the battery should become necessary and also on days reserved for experiments when no experiments are planned.

5.4.1 Mode D Failure Conditions

i) Normally, Mode D is used if the battery is in a poor state of charge and in need of rapid recharging at the expense of not operating the repeater experiments. The experiment control logic will automatically place the spacecraft in Mode D (regardless of the existing Mode) if the battery voltage continues to drop to a second preset cutoff level of 12.1 volts. As in the failure mode discussed for Mode C above, if one or more of the cells in the battery should fail, or if a heavy current surge is experienced, the Mode D cutoff level may be reached even though the battery is not in need of recharge. In this case it will be necessary to command the satellite to Mode A or B manually (depending upon the scheduled day) in order to override the voltage cutoff circuit. (This resetting may have to be done frequently.)

ii) In Mode D, all commands must be accomplished through command channel A. The 435.1 MHz beacon should be left ON to obtain telemetry data, unless the battery is in a critical state of discharge (below 12.0 volts). If the battery should drop any further than this level, the telemetry systems will cease to function due to loss of negative voltage output from the instrumentation switching regulator power supplies. If the spacecraft is commanded to Mode D, the 435.1 MHz beacon should be operated continuously, to provide telemetry data, unless the battery voltage is very low (approaching 12.1 volts), in which case it should only be turned ON for ten minutes during each reference orbit (the first orbit of each Greenwich day) to permit the gathering of telemetry data.

iii) If the two-to-ten meter receiver or command channel A is not functioning, the spacecraft should be kept out of Mode D and placed in Mode C (if recharging of the battery is needed) or Mode B (if the battery is charged to above the Mode C cutoff point of 12.4 volts). It should always be kept in one of these two modes; otherwise, if the battery stays below the Mode D cutoff voltage (12.1 volts), the experiment control logic may continually keep the satellite in Mode D where it won't be possible to override it by command.

5.5 Morse Code Telemetry

Normally, Morse code telemetry will be available on the 29.50 MHz beacon when the spacecraft is in Mode A, and the 145.98 MHz beacon when the spacecraft is in Mode B or C. The speed should be kept at 20 WPM, unless there is a need to use the 10 WPM speed temporarily. If for some reason 10 WPM is commanded, the encoder should be commanded back to 20 WPM before the end of the pass. Changing of the code speed should be used mainly as a means of checking the satellite's response to ground command (especially to verify that a particular ground telecommand station is working properly). The encoder may be used at 10 WPM during educational demonstrations (normally conducted during local morning passes).

5.5.1 Morse Code Telemetry System Failure Conditions

i) In the event of failure of the Morse code telemetry encoder, the teletype telemetry encoder should be commanded to the 145.98 MHz beacon (in the AFSK mode) and the 29.50 and 435.1 MHz beacon (in the FSK mode), the latter being the normal beacon for the teletype telemetry. If the battery voltage should drop below 12.0 volts, the Morse code telemetry system may begin to generate meaningless numbers because of loss of negative bias from the instrumentation switching regulator. In this event, the spacecraft should be commanded into Mode D (if not in this mode already via the undervoltage sensors), and the 435.1 MHz beacon should be turned OFF to permit recharging at a maximum rate. The 435.1 MHz beacon should be turned ON on each reference orbit to see if telemetry has recovered.

ii) If we should encounter a failure of the 29.50 MHz beacon (but not of the two-to-ten meter repeater itself), Morse code telemetry should be switched to the 435.1 MHz beacon between approximately 1200 and 2400 GMT, and FSK teletype to this beacon at all other times. When in Mode A, Morse code telemetry should be put on the 2304 MHz beacon and the beacon should be turned on immediately upon AOS on the reference orbit (the first orbit in Mode A of the Greenwich day).*

iii) In case of failure of the 145.98 MHz beacon (but not of the 70 cm-to-2 m repeater), Morse code telemetry should be put on the 2304 MHz beacon and the beacon should be turned on immediately upon AOS on the reference orbits (the first orbit in Mode B of the Greenwich day).*

5.6 Teletype Telemetry

Teletype telemetry will normally be on the 435.1 MHz beacon (as 850-Hz FSK), and so can only be heard in Mode A or D. The status channels of the teletype telemetry can be used to verify receipt of commands (including a reading of the last received command), and should be used as a means of verifying that the ground telecommand station is working properly. The transmitted command carrier should be left ON during this verification procedure to prevent noise bursts from entering the status channels and affecting the resultant data. If the command status bits appear to be changing at random with the command carrier ON, this is an indication that the link is not "locked up."

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*The U. S. Federal Communications Commission has notified AMSAT that the 2304 MHz beacon should be "prevented from transmitting" until further notice.

5.6.1 Teletype Telemetry System Failure Conditions

i) If the teletype telemetry encoder ceases to function, Morse code telemetry should be switched to the 435.1 MHz beacon, and Codestore switched to the 29.50 MHz beacon on Mode A days (unless Codestore is not loaded, in which case Morse code telemetry should be sent on the 29.50 MHz beacon also). On Mode B days Morse code telemetry should be sent on the 145.98 MHz beacon as this will be the only source of telemetry in this mode.

ii) If the 435.1 MHz beacon should fail, follow the procedure for this failure condition described in Section 5.1.1(ii).

5.7 Codestore Message Storage Unit

If possible, Codestore should contain a message at all times. During initial weeks, a reference orbit, the orbital period, longitude increment, and Mode A/ Mode B operating schedule as well as the HI identifier should be loaded and updated regularly because of the critical need to disseminate this information as quickly as possible. Codestore has a capacity of 896 bits (about 18 five-letter words), as with OSCAR 6, but there is no "autoload" capability. This means that the spacecraft must be commanded into the Codestore "load" mode before it is loaded and back to the "run" mode before the message is retrieved. If, when listening for Codestore, nothing is heard, it should be commanded to the "run" mode and left there. Remember also to listen for the message on the beacon downlink while it is being loaded; this is a good means of verifying that the spacecraft is accepting the load. Codestore should be loaded at least once a week, and switched onto the 29.50 or 145.98 MHz beacon at least once a day, preferably on the reference orbit.

5.7.1 Codestore Failure Conditions

i) If Codestore fails to retain its message more than a few hours, it should be left off the beacons except for special experiments.

ii) If Codestore retains its message for only a few days, it should be reloaded as often as necessary to keep the message readable and accurate, as well as up-to-date.

iii) If the Codestore unit fails to load, it should be left off the beacons, but should be checked periodically to see if it has recovered. Be certain that the problem is not at the ground loading station, as the unit must be loaded correctly with careful attention to procedure.

5.8 Command Decoders

Command decoder "A" is the primary command decoder system to be used. Decoder "B" serves as a backup and is not normally used. Command status verification (by means of the teletype telemetry status channels) is possible only for decoder "A" and not for decoder "B" (see Section 9.2).

5.8.1 Command Decoder Failure Conditions

i) In the event of a failure of decoder "A", use decoder "B". If decoder "A" fails to work only for some functions, use the backup commands for that decoder, or if this fails, use decoder "B" for all functions.

ii) If there is a failure of command receiver channel A, the satellite should not be commanded into Mode A or D, or else command capability will be lost for 24 hours until the onboard clock resets the spacecraft into Mode B.

iii) If there is a failure of the command receiver channel B, the satellite should not be commanded into Mode B or C or else command capability will be lost for 24 hours until the onboard clock resets the spacecraft into Mode A.

5.9 Power System

At beginning of life, the OSCAR 7 solar panels should be capable of providing as much as 16 watts in sunlight (about 10 watts orbit average, assuming an 80% sunlit orbit). The solar cells and six ampere-hour rechargeable nickel-cadmium battery should be adequate to power the spacecraft with a positive power budget even if there is a degradation below the original power (which might occur over the course of several years due to radiation damage to the solar cells). Normally, the battery will not be discharged below about 5 to 10% of its full-charge level.

5.9.1 Power System Failure Conditions

i) The ground telecommand stations should be prepared to switch the satellite into Mode C if a 60% battery discharge level (3.6 AH discharge) is reached (this occurs if the battery voltage drops below 12.4 volts), and to Mode D if the battery discharge level drops further to 70% (4.2 AH discharge) depth of discharge (this occurs if the battery voltage drops below 12.1 volts). In case of improper operation of these cutoff sensors, they should be overridden by commanding to the proper mode (Mode A or B). This may be necessary, for example, if there is a loss of one or more cells of the ten-cell battery which might cause the battery voltage to drop to the cutoff point even though the remaining cells might be in a good state of charge (see also the procedures outlined for this condition in Sections 5.3.1 and 5.4.1). Heavy current surges may also cause the spacecraft to switch into Mode D. In any case, the battery must not be allowed to drop below 12.0 volts. Below this level there is a loss of negative voltage output from the instrumentation switching regulator power supplies, and this will cause a loss of both the teletype and Morse code telemetry systems (all channels will read zero or else meaningless numbers.)

ii) If there is a loss of one or more of the solar panels, or excessive degradation in their power output, or loss in capacity or charge efficiency of the nickel-cadmium battery, or battery drain from one or more of the experiments becomes excessive, it may be necessary to operate in Mode C on alternate days instead of Mode B to permit additional battery charging. If additional action is needed, the 435 MHz beacon should be operated less frequently. If these measures are insufficient, it may be necessary to reduce average power consumption still further by going to Mode D during a portion of each day, but still maintaining the 48-hour cycle between the two repeaters.

iii) The spacecraft contains two battery charge regulators. Normally, regulator #1 will be in operation. If it should fail, it should automatically switch over to regulator #2. If for some reason switchover does not occur, the battery will be discharging continuously and therefore it is imperative that the #2 regulator be commanded on as soon as possible. If the #2 regulator fails, be sure to command to the #1 regulator; if neither regulator is working, this is an emergency condition and the spacecraft should be kept in Mode D with the 435 and 2304 MHz beacons OFF (this will require daily commands to Mode D unless the battery voltage has dropped sufficiently for the undervoltage sensor to keep it in this mode). Once a day during the reference orbit, the 435 MHz beacon should then be turned ON for several frames of teletype telemetry and then for several frames of Morse code telemetry, and the battery charge regulator should be commanded from #1 to #2 (or vice versa) while the spacecraft is in sunlight, to see if one of the regulators has recovered. Spacecraft lifetime will only be 100-200 hours in this condition before the battery becomes fully discharged.

5.10 Experiment Control Logic

The experiment control logic (ECL) controls nearly all functions of the repeaters and beacons, including switching them ON and OFF and selecting the telemetry modulation sources. It also contains the undervoltage sensors and 24-hour spacecraft clock which switches between the operating modes.

5.10.1 Experiment Control Logic Failure Conditions

i) If for some reason there should be a temporary loss of power in the spacecraft (defined as when the bus voltage goes below 12.0 volts), the spacecraft should be commanded to the proper operating conditions after power has been restored. This includes putting the spacecraft in Mode A or B, turning ON the 435 MHz beacon, keeping the 2304 MHz beacon OFF, resetting the clock at 0000 GMT, and selecting the proper telemetry system for the proper beacons. The two-to-ten meter repeater should be kept in the full-sensitivity mode, and Morse code telemetry should be kept at 20 WPM.

ii) If the ECL is unable to select the proper telemetry encoder or modulation source or beacon, the backup procedures outlined for the Mode A and B Morse code and teletype telemetry system failure conditions should be followed.

iii) If the 24-hour clock should fail, the spacecraft should be commanded to the correct mode (A or B) daily ten minutes after the reference orbit equatorial crossing.

iv) If the battery voltage appears to be approaching 12.0 volts and the undervoltage sensor fails to switch into Mode D, this switching should be done manually.

6.0 SUGGESTED EXPERIMENTS

Generally, one day a week will be reserved for special experiments, although experiments can be scheduled at other times as well if they will not interfere with the normal operation of the two repeaters. In the event that no experiments are planned, the spacecraft should be left in Mode D, with the 435 MHz beacon commanded ON in the teletype telemetry mode. The two repeaters will not be available for general use unless a specially planned experiment has been arranged with AMSAT. All users are invited and encouraged to originate experiments, which can be of a technical, operations, application, or demonstration nature. Listed below are suggested experiments as a guide to what can be done with the experimental subsystems onboard AMSAT-OSCAR 7.

6.1 Two-to-ten Meter and 70 cm-to-2 m Repeater Experiments

A. Educational demonstrations in schools.

B. Ranging (distance measurement) experiments to determine satellite or user position.

C. Small-terminal user experiments using hand-held equipment, or equipment operated from an automobile, airplane, boat, bicycle or motorcycle.

D. Emergency communications demonstrations with portable equipment.

E. Medical data exchange experiments, including possibly the transmission of analog or digital physiological data (see 4X4MH's proposal in the September 1973 issue of the "AMSAT Newsletter," pages 13-14).

F. Data collection from remote, unattended ground terminals.

G. Slow-scan and medium-scan television experiments.

H. Remote control experiments.

I. Repeater interlinking experiments (this will require approval by the government licensing authority).

J. Multiple-access experiments, particularly quantitative experiments to determine reduction in S/N due to power sharing, for different modulation techniques.

K. Ground station automation experiments (closed-loop monitoring of downlink and adjustment of uplink power and frequency automatically).

L. "Broadcast" demonstrations using the repeater in a single-access mode, and measuring downlink S/N for different modulation modes.

M. Extended range communications experiments to attempt transmission or reception beyond the normal maximum communications range.

N. Minimum power user experiments, to determine the minimum power needed to establish communications under controlled, single-access conditions.

O. Traffic nets scheduled on the satellite.

P. Automatic tracking of ground station antennas (either on an open-loop or closed-loop basis).

6.2 435.1 MHz Beacon Experiments

A. Inverted and Arrested Doppler propagation experiments (see the report by W0LER and W0MJS in the June 1973 issue of the *AMSAT Newsletter*, pages 10-14).

B. Aurora propagation experiments.

C. Scintillation effect quantitative measurements.

D. Doppler measurements (used for orbit determination).

E. Frequency splitting or "twinning" propagation experiments.

F. Utilizing Codestore with beacon as a single channel repeater.

6.3 2304.1 MHz Beacon Experiments

A. Propagation experiments.

B. Doppler measurements (used for orbit determination).

C. Downlink interference measurements (with radar).

6.4 Codestore Experiments

A. Teletype message storage experiments (Mark only, at quarter-speed).

B. Real-time message retransmission (Codestore in the "repeater" mode, in which the unit transmits its message while it is being loaded).

C. Delayed, stored-QSO demonstrations.

D. Bulletin transmission demonstrations.

E. Message loading or retrieval from remote, unattended terminals.

F. Interrogation of remote terminals using preassigned addresses.

6.5 Teletype and Morse Code Telemetry Experiments

A. Unattended, automatic telemetry data collection (using tape recorders, or "autostart" terminal units with phaselock detectors).

B. Online (or offline) computer processing of received telemetry data, with printout of parameter values and units.

C. Automatic computer processing of teletype status bits to provide printout of spacecraft operating conditions.

D. Use of teletype status bits for real-time verification of commands.

E. Experiments involving physical parameters, e.g., determination of spacecraft orientation and spin characteristics from solar panel currents and Z axis sensor information. (Note that the teletype telemetry encoder can be put in a "dwell" mode on any particular channel as needed for these experiments.)

6.6 Command System Experiments

A. Automatic transmission of commands at preprogrammed times.

B. Automatic verification of command acceptance.

C. Programming the list of commands to be sent to the satellite, with the capability of changing the commands from orbit to orbit (so that Codestore can be turned ON during particular passes, for example).

D. Automatic printout of commands transmitted, listing the actual commands sent, with dates, times and orbit numbers, for command station logging purposes.

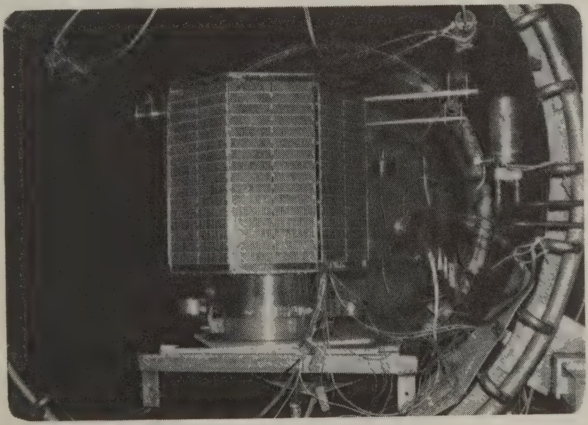
E. Automatic logging of spacecraft states (including mode), with dates, times and orbit numbers, for space station logging purposes. For example, determine and log which repeater and/or beacon(s) are in operation.

F. Automatic closed-loop control of command sequence according to observed spacecraft state. For example, if the Morse code telemetry system is found to be at 10 WPM instead of 20 WPM, the speed could be switched automatically to 20 WPM.

G. Turning ON and OFF the command transmitter automatically, and automatically tracking the command transmitter antennas.

6.6.1 Important Note to All Telecommand Stations

It is extremely important that all AMSAT-OSCAR 7 telecommand stations keep detailed logs of all command transmissions for collection and retention by AMSAT as licensee of the space station. Special command log forms have been prepared by AMSAT for this purpose, and should be submitted by each telecommand station monthly. It is imperative that all spacecraft commands be traceable back to the telecommand station who sent them.



THE AMSAT-OSCAR-7 SPACECRAFT IN THE THERMAL-VACUUM TEST CHAMBER

7.0 CALIBRATION EQUATIONS FOR THE AMSAT-OSCAR 7 MORSE CODE TELEMETRY SYSTEM

Line No. ↴ ↱ N
$X\overbrace{12}$

Channel	Measured Parameter	Measurement Range	Preliminary Calibration Equation
1A	Total Solar Array Current	0 to 3000 ma.	$I_T = 29.5\ N$ (ma.)
1B	+X Solar Panel Current	0 to 2000 ma.	$I_{+x} = 1970 - 20\ N$ (ma.)
1C	-X Solar Panel Current	0 to 2000 ma.	$I_{-x} = 1970 - 20\ N$ (ma.)
1D	+Y Solar Panel Current	0 to 2000 ma.	$I_{+y} = 1970 - 20\ N$ (ma.)
2A	-Y Solar Panel Current	0 to 2000 ma.	$I_{-y} = 1970 - 20\ N$ (ma.)
2B	RF Pwr. Out-70/2 Rptr.	0 to 8 watts	$P_{70/2} = 8\ (1 - 0.01\ N)^2$ (watts)
2C	24-hour Clock Time	0 to 1440 minutes	$t = 14.4\ N$ (min.) or $0.24\ N$ (hrs.)
2D	Bat. Charge-Discharge Current	-2000 to +2000 ma.	$I_B = 40\ (N - 50)$ (ma.)
3A	Battery Voltage	6.4 to 16.4 volts	$V_B = 0.1\ N + 6.4$ (volts)
3B	Half-Battery Voltage	0 to 10 volts	$V_{\frac{1}{2}B} = 0.10\ N$ (volts)
3C	Bat. Charge Reg. #1 Vtge.	0 to 15 volts	$V_{cr1} = 0.15\ N$ (volts)
3D	Battery Temperature	-30° to +50° C.	$T_{Bat} = 95.8 - 1.48\ N$ (°C.)
4A	Baseplate Temperature	-30° to +50° C.	$T_{bp} = 95.8 - 1.48\ N$ (°C.)
4B	PA Temp. - 2/10 Rptr.	-30° to +50° C.	$T_{10} = 95.8 - 1.48\ N$ (°C.)
4C	+X Facet Temperature	-30° to +50° C.	$T_{+x} = 95.8 - 1.48\ N$ (°C.)
4D	+Z Facet Temperature	-30° to +50° C.	$T_{+z} = 95.8 - 1.48\ N$ (°C.)
5A	PA Temp. - 70/2 Rptr.	-30° to +50° C.	$T_2 = 95.8 - 1.48\ N$ (°C.)
5B	PA Emit. Curr. - 2/10 Rptr.	0 to 1167 ma.	$I_{10} = 11.67\ N$ (ma.)
5C	Modulator Temp. - 70/2 Rptr.	-30° to +50° C.	$T_m = 95.8 - 1.48\ N$ (°C.)
5D	Instr. Sw. Reg. Input Curr. (@ 14.3V)	0 to 93 ma.	$I_{isr} = 11 + 0.82\ N$ (ma.)
6A	RF Power Out - 2/10 Rptr.	0 to 10,000 mw.	$P_{2/10} = N^2$ (milliwatts)
6B	RF Power Out - 435 Beacon	0 to 1,000 mw.	$P_{435} = 0.1\ N^2$ (milliwatts)
6C	RF Power Out - 2304 Beacon	0 to 100 mw.	$P_{2304} = 0.01\ N^2$ (milliwatts)
6D	Midrange Telemetry Calibration	0.500 volts	$N = 50 \pm 1$ counts

8.0 CALIBRATION EQUATIONS FOR THE AMSAT-OSCAR 7 TELETYPE TELEMETRY SYSTEM

Channel No. $\overbrace{XX}^{\downarrow}\overbrace{123}^{\downarrow N}$

Channel	Measured Parameter	Measurement Range	Calibration Equation (at 25°C.)
00	PA Temp. - 70/2 Rptr.	-30° to +50°C.	$T_2 = 95.79 - 0.1480\ N$ (°C.)
01	+X Solar Panel Current	0 to 2000 ma.	$I_{+x} = 1995 - 2.191\ N$ (ma.)
02	+Y Solar Panel Current	0 to 2000 ma.	$I_{+y} = 1968 - 2.175\ N$ (ma.)
03	-X Solar Panel Current	0 to 2000 ma.	$I_{-x} = 1953 - 2.150\ N$ (ma.)
04	-Y Solar Panel Current	0 to 2000 ma.	$I_{-y} = 1954 - 2.150\ N$ (ma.)
05	+Z Axis Orientation	0 to 90°	$\theta_z = \arccos (N/N_{max})$ (deg. from Z axis)
06	+X Solar Panel Current	0 to 2000 ma.	$I_{+x} = 1995 - 2.191\ N$ (ma.)
07	+Y Solar Panel Current	0 to 2000 ma.	$I_{+y} = 1968 - 2.175\ N$ (ma.)
08	-X Solar Panel Current	0 to 2000 ma.	$I_{-x} = 1953 - 2.150\ N$ (ma.)
09	-Y Solar Panel Current	0 to 2000 ma.	$I_{-y} = 1954 - 2.150\ N$ (ma.)
10	-Z Axis Orientation	0 to 90°	$\theta_{-z} = \arccos (N/N_{max})$ (deg. from Z axis)
11	Battery Voltage	6.4 to 16.4 V.	$V_B = 0.01\ N + 6.40$ (volts)
12	Half-Battery Voltage	0 to 10 V.	$V_{\frac{1}{2}B} = 0.01045\ N$ (volts)
13	28V. Regulator Voltage	0 to 34 V.	$V_{28} = 0.034\ N$ (volts)
14	10V. Regulator Voltage	0 to 15 V.	$V_{10} = 0.01558\ N$ (volts)
15	9V. Regulator Voltage	0 to 10 V.	$V_9 = 0.01\ N$ (volts)
16	Battery Charge Reg. #1 Voltage	0 to 15 V.	$V_{cr1} = 0.015\ N$ (volts)
17	Battery Charge Reg. #2 Voltage	0 to 15 V.	$V_{cr2} = 0.015\ N$ (volts)
18	Ground-Zero Telemetry Cal.	0 V.	$V_o = 0.00$ (volts); $N = 000 \pm 1$ count
19	RF Power Out - 2304 Beacon	0 to 100 mw.	$P_{2304} = (N/100)^2$ (mw.)
20	Battery Charge-Discharge Curr.	-1500 to +1500 ma.	$I_B = 3.08\ N - 1474$ (ma.)
21	+X Solar Panel Current	0 to 2000 ma.	$I_{+x} = 1995 - 2.191\ N$ (ma.)
22	+Y Solar Panel Current	0 to 2000 ma.	$I_{+y} = 1968 - 2.175\ N$ (ma.)
23	-X Solar Panel Current	0 to 2000 ma.	$I_{-x} = 1953 - 2.150\ N$ (ma.)
24	-Y Solar Panel Current	0 to 2000 ma.	$I_{-y} = 1954 - 2.150\ N$ (ma.)
25	+Z Axis Orientation	0 to 90°	$\theta_{+z} = \arccos (N/N_{max})$ (deg. from Z axis)
26	+X Solar Panel Current	0 to 2000 ma.	$I_{+x} = 1995 - 2.191\ N$ (ma.)
27	+Y Solar Panel Current	0 to 2000 ma.	$I_{+y} = 1968 - 2.175\ N$ (ma.)
28	-X Solar Panel Current	0 to 2000 ma.	$I_{-x} = 1953 - 2.150\ N$ (ma.)
29	-Y Solar Panel Current	0 to 2000 ma.	$I_{-y} = 1954 - 2.150\ N$ (ma.)

8.0 CALIBRATION EQUATIONS FOR THE AMSAT-OSCAR 7 TELETYPE TELEMETRY SYSTEM (cont'd.)

Channel	Measured Parameter	Measurement Range	Calibration Equation (at 25°C.)
30	-Z Axis Orientation	0 to 90°	$\theta_{-z} = \arccos (N/N_{max})$ (deg. from Z axis)
31	RF Power Out - 2/10 Repeater	0 to 10,000 mw.	$P_{2/10} = (N/10)^2$ (milliwatts)
32	RF Power Out - 70/2 Repeater	0 to 8 watts	$P_{70/2} = 8\ (1 - 0.001\ N)^2$ (watts)
33	RF Power Out - 435 Beacon	0 to 1000 mw.	$P_{435} = 0.001\ N^2$ (milliwatts)
34	Total Solar Panel Current	0 to 3000 ma.	$I_T = 3.115\ (N - 7)$ (ma.)
35	Battery Temperature	-30° to +50° C.	$T_{Bat} = 95.79 - 0.1480\ N$ (°C.)
36	Baseplate Temperature	-30° to +50° C.	$T_{bp} = 95.79 - 0.1480\ N$ (°C.)
37	+X Facet Temperature	-30° to +50° C.	$T_{+x} = 95.79 - 0.1480\ N$ (°C.)
38	+Z Facet Temperature	-30° to +50° C.	$T_{+z} = 95.79 - 0.1480\ N$ (°C.)
39	2304 Beacon Temperature	-30° to +50° C.	$T_{2304} = 95.79 - 0.1480\ N$ (°C.)
40	Midrange Telemetry Calibration	0.500 ± 0.005 V.	$V = 0.001\ N$ (volts) $(N = 500 \pm 5)$
41	+X Solar Panel Current	0 to 2000 ma.	$I_{+x} = 1995 - 2.191\ N$ (ma.)
42	+Y Solar Panel Current	0 to 2000 ma.	$I_{+y} = 1968 - 2.175\ N$ (ma.)
43	-X Solar Panel Current	0 to 2000 ma.	$I_{-x} = 1953 - 2.150\ N$ (ma.)
44	-Y Solar Panel Current	0 to 2000 ma.	$I_{-y} = 1954 - 2.150\ N$ (ma.)
45	+Z Axis Orientation	0 to 90°	$\theta_{+z} = \arccos (N/N_{max})$ (deg. from Z axis)
46	+X Solar Panel Current	0 to 2000 ma.	$I_{+x} = 1995 - 2.191\ N$ (ma.)
47	+Y Solar Panel Current	0 to 2000 ma.	$I_{+y} = 1968 - 2.175\ N$ (ma.)
48	-X Solar Panel Current	0 to 2000 ma.	$I_{-x} = 1953 - 2.150\ N$ (ma.)
49	-Y Solar Panel Current	0 to 2000 ma.	$I_{-y} = 1954 - 2.150\ N$ (ma.)
50	-Z Axis Orientation	0 to 90°	$\theta_{-z} = \arccos (N/N_{max})$ (deg. from Z axis)
51	Battery Voltage	6.4 to 16.4 V.	$V_B = 0.01\ N + 6.45$ (volts)
52	Half-Battery Voltage	0 to 10 V.	$V_{\frac{1}{2}B} = 0.01052\ N$ (volts)
53	AGC Level - 70/2 Rptr.	0 to 29 dB	$AGC = 20 \log_{10} (1093 - N) - 60$ (dB)
54	TX Osc. Test Pt. - 70/2 Repeater	0 to 100%	N(TX OSC) = 977 (typical)
55	RX Osc. Test Pt. - 70/2 Repeater	0 to 100%	N(RX OSC) = 316 (typical)
56	Modulator Out. - 70/2 Repeater	0 to 1 V.	$MOD = 0.00128\ N$ (volts)
57	Envelope Level - 70/2 Repeater	0 to 1 V.	$ENV = 0.00128\ N$ (volts)
58	AGC Level - 2/10 Rptr.	0 to 27 dB	$AGC = 10 \log_{10} (N-500)$ (dB)
59	CONV Osc. Test Pt. - 70/2 Repeater	0 to 10 V.	$CONV = 0.01\ N$ (volts)

9.0 INTERPRETATION OF THE STATUS WORDS IN TELETYPE TELEMETRY CHANNELS 60 - 79

The seventh and eighth lines of telemetry data from the teletype telemetry encoder are spacecraft status words, coded in octal (base 8) form. Two status words are sent alternately, "satellite clock time" (sent in teletype telemetry channels 60, 62, 64, 66, 68, 70, 72, 74, 76, and 78), and spacecraft state/mode (sent in channels 61, 63, 65, 67, 69, 71, 73, 75, 77, and 79).

Each status word consists of five octal numbers. The first (left-most) digit is not used and should be disregarded. The second, third, fourth and fifth digits are octal numbers containing the status information.

9.1 Satellite Clock Time (Teletype Telemetry Channels 60, 62, 64, 66, 68, 70, 72, 74, 76, and 78)

Satellite clock time is telemetered in AMSAT-OSCAR 7 to permit identification of the approximate time that a frame of telemetry was recorded. The clock increments every 96 minutes and repeats again from zero every 273 days. The clock reading is telemetered as a five-digit word in octal form. For example, the word X3746 represents a clock count of $(3 \times 8^3) + (7 \times 8^2) + (4 \times 8^1) + (2 \times 8^0) =$

$$1536 + 448 + 32 + 6 = 2022$$

(The left-most digit, represented above as "X" is not used and should be disregarded. It will generally be zero.) At 96-minute intervals, the word would increment to X3747, then X3750, then X3751, and so forth.

9.2 Spacecraft State/Mode (Teletype Telemetry Channels 61, 63, 65, 67, 69, 71, 73, 75, 77, and 79)

The state/mode of the spacecraft is transmitted in octal form in five digit words. The first digit is not used and will usually be zero. The second, third and fourth digits are command status words corresponding to the last command received by the spacecraft command system. This information can be interpreted by means of the command status word table given on the following page.

The fourth and fifth digits provide information on the Mode (i.e., whether the satellite is in Mode A, B, C, or D), and whether the 435 MHz and 2304 MHz beacons are ON or OFF in accordance with the table on the next page.

KARIN MEINZER (DJ4ZC's XYL), MARIE MARR, DICK DANIELS WA4DGU, DR. KARL MEINZER DJ4ZC, AND JAN KING W3GEY PREPARE AMSAT-OSCAR 7 TO GO INTO THE THERMAL-VACUUM TEST CHAMBER (SEEN IN THE BACKGROUND).

TABLE OF COMMAND STATUS WORDS IN TELETYPE TELEMETRY CHANNELS
61, 63, 65, 67, 69, 71, 73, 75, 77 and 79

	status word						status word				
CMND #	digit: 1	2	3	4	5	CMND #	digit: 1	2	3	4	5
01	0	7	0	ev	X	19	0	6	0	od	X
02	0	3	1	ev	X	20	0	2	3	ev	X
03	0	3	2	ev	X	21	0	2	5	ev	X
04	0	3	4	ev	X	22	0	2	1	od	X
05	0	3	0	od	X	23	0	2	6	ev	X
06	0	5	1	ev	X	24	0	2	2	od	X
07	0	5	2	ev	X	25	0	2	4	od	X
08	0	5	4	ev	X	26	0	4	3	ev	X
09	0	5	0	od	X	27	0	4	5	ev	X
10	0	1	3	ev	X	28	0	4	1	od	X
11	0	1	5	ev	X	29	0	4	6	ev	X
12	0	1	1	od	X	30	0	4	2	od	X
13	0	1	6	ev	X	31	0	4	4	od	X
14	0	1	2	od	X	32	0	0	7	ev	X
15	0	1	4	od	X	33	0	0	3	od	X
16	0	6	1	ev	X	34	0	0	5	od	X
17	0	6	2	ev	X	35	0	0	6	od	X
18	0	6	4	ev	X						

Note: "X" can be any number and can be disregarded.
"od" represents an odd number (1, 3, 5, or 7).
"ev" represents an even number (0, 2, 4, or 6).

The fourth digit of the status word is an indication whether the spacecraft is in Mode A, B, C, or D as follows:

	Fourth status bit
Mode A	4 or 5
Mode B	6 or 7
Mode C	2 or 3
Mode D	0 or 1

10.0 AMSAT-OSCAR-7 OPERATING MODES

CMND #

1 - MODE A SELECT - 2/10 RPTR ON AND/OR 435 BEACON ON, 70/2 RPTR OFF.

2 - MODE B SELECT - 70/2 RPTR ON AT FULL-POWER, 2/10 RPTR OFF, 435 BEACON OFF.

3 - 435 BEACON ON (DURING MODE A OR MODE D ONLY).

4 - 435 BEACON OFF.

5 - CODESTORE - RUN MODE.

6 - CODESTORE - LOAD MODE.

7 - MORSE CODE TELEMETRY - 20 WPM.

8 - MORSE CODE TELEMETRY - 10 WPM.

9 - 2/10 RPTR - FULL SENSITIVITY.

10 - 2/10 RPTR - REDUCED SENSITIVITY (-14 dB).

11 - 435 BEACON - CODESTORE KEYING.

12 - 435 BEACON - MORSE CODE TELEMETRY KEYING.

13 - 435 BEACON - TELETYPE TELEMETRY KEYING.

14 - 29.50 OR 145.98 BEACON - MORSE CODE TELEMETRY KEYING.

15 - 29.50 OR 145.98 BEACON - CODESTORE KEYING.

16 - 29.50 OR 145.98 BEACON - TELETYPE TELEMETRY KEYING.

17 - RESET 24-HOUR SATELLITE CLOCK.

18 - MODE C SELECT - 70/2 RPTR ON AT QUARTER-POWER, 2/10 RPTR OFF, 435 BEACON OFF.

19 - MODE D SELECT - RECHARGE MODE; 70/2 RPTR OFF, 2/10 RPTR OFF. NOTE - 435 BEACON CAN BE OPERATED IN THIS MODE.

20 - CHARGE REGULATOR NO. 1 SELECT.

21 - CHARGE REGULATOR NO. 2 SELECT.

22 - TELETYPE TELEMETRY - DWELL MODE.

23 - TELETYPE TELEMETRY - RUN MODE.

24 - 2304 BEACON ON (FOR 14 MINUTES ONLY). NOTE - THIS BEACON IS OPERABLE IN ALL MODES.

25 - 2304 BEACON OFF.

26 - 2304 BEACON - INTERNAL KEYING.

27 - 2304 BEACON - MORSE CODE TELEMETRY KEYING.

28 - TELETYPE TELEMETRY - FSK MODE.

29 - TELETYPE TELEMETRY - AFSK MODE.

30 - MODE A SELECT (REDUNDANT TO #1).

31 - MODE B SELECT (REDUNDANT TO #2).

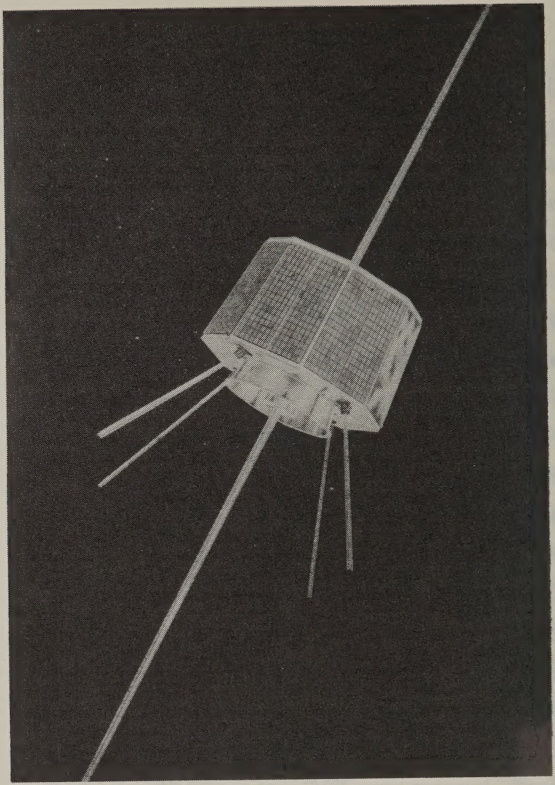
32 - 435 BEACON ON (REDUNDANT TO #3).

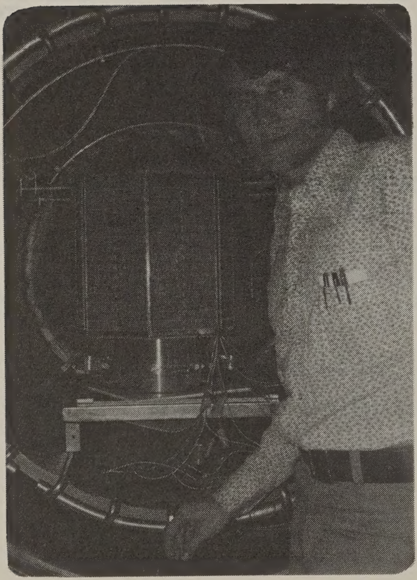
33 - 435 BEACON OFF (REDUNDANT TO #4).

34 - MODE C SELECT (REDUNDANT TO #18).

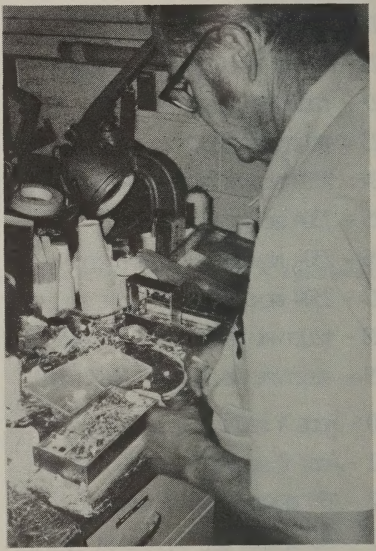
35 - MODE D SELECT (REDUNDANT TO #19).

AN ARTIST'S RENDITION OF THE AMSAT-OSCAR 7 SATELLITE IN ORBIT





JAN KING W3GEY, AMSAT-OSCAR 7 PROJECT MANAGER, INSPECTS THE SPACECRAFT IN THE THERMAL-VACUUM TEST CHAMBER.



BUCK MOORE W3ZKI, POTTING THE AMSAT-OSCAR 7 TWO-TO-TEN METER REPEATER WITH ECCOFOAM FPH.

AMSAT

Radio Amateur Satellite Corporation

P.O. BOX 27, WASHINGTON, D.C. 20044

The Radio Amateur Satellite Corporation (AMSAT) is a non-profit, tax-exempt 501(c)(3) scientific corporation founded in the greater Washington, D.C. area in early 1969. AMSAT's purposes and objectives are:

A. To provide satellites that can be used for amateur radio communication and experimentation by suitably equipped amateur radio stations throughout the world on a non-discriminatory basis.

B. To encourage development of skills and the advancement of specialized knowledge in the art and practice of amateur radio communications and space science.

C. To foster international goodwill and cooperation through joint experimentation and study, and through the wide participation in these activities on a noncommercial basis by radio amateurs of the world.

D. To facilitate communications by means of amateur satellites in times of emergency.

E. To encourage the more effective and expanded use of the higher frequency amateur bands.

F. To disseminate scientific, technical and operational information derived from such communications and experimentation, and to encourage publication of such information in treatises, theses, trade publications, technical journals or other public media.

AMSAT is a membership organization open to all radio amateurs and interested non-amateurs. AMSAT encourages the participation of all interested individuals in its activities regardless of membership, and invites licensed amateur radio operators of all countries to engage in radio transmissions to the satellites.

AMSAT's operating funds are derived entirely from donations, membership dues, and grants from the American Radio Relay League (ARRL) and other such organizations. Most of the spacecraft construction and associated program activity has centered in the Washington, D.C. area, with assistance from affiliated groups in California, Texas, Australia, Canada and West Germany.

Since its creation in 1969, AMSAT has been responsible for two highly successful satellite projects, and is currently involved in a third program -

o Australis-OSCAR 5 - a satellite built by students at Melbourne University in Australia. Launched by NASA in January 1970, AMSAT completed extensive modifications, testing, launch arrangements, licensing and data collection for this satellite project.

o AMSAT-OSCAR 6 - First of a series of long-lifetime operational amateur satellites, OSCAR 6 continues to serve for regular use by approximately 2,000 amateurs in over 74 countries since its launch by NASA in October 1972. AMSAT was responsible for the spacecraft design, fabrication, testing, launch arrangements, licensing and operation. This project resulted in the presentation of the 1972 ARRL Technical Merit Award to AMSAT, "for outstanding leadership in amateur space communication resulting in the success of the OSCAR 6 mission."

o AMSAT-OSCAR-B (OSCAR 7) - This amateur communications satellite is now in final testing for a launch by NASA later this year. Expected to remain operational for three years or more, OSCAR 7's subsystems have been developed by amateur groups in the United States, Australia, Canada, and West Germany under AMSAT's management.

AMSAT-OSCAR 6 REFERENCE ORBITS AND OPERATING SCHEDULE

Currently, the AMSAT-OSCAR 6 two-to-ten meter repeater is ON for communications during south-to-north (local evening ascending node) passes on Mondays, Thursdays and Saturdays (GMT days), and for experiments and educational demonstrations on Tuesday and Friday north-to-south (local morning descending node) passes. Sunday mornings are also ON for north-to-south (local morning) passes.

The updated reference orbit data given below for AMSAT-OSCAR 6 are supplied by AMSAT. Times are in GMT, and Longitudes are in degrees west of Greenwich. A more complete printout of all the orbits for a 1 to 2-month period is available from AMSAT, P. O. Box 27, Washington, D.C. 20044 USA, in return for your report of communications use of OSCAR 6.

Period = 114.99455 minutes. Longitude increment = 28.7487 degrees per orbit.

Note that orbits repeat on a 263-orbit cycle every three weeks (i.e., each 21 days), but 3.6 minutes later and 0.9 degrees further west.

REV	DATE		TIME Z	LONG W
8958	OCT	1	0110.9	66.1
8970	OCT	2	0010.8	51.1
8983	OCT	3	0105.8	64.8
8995	OCT	4	0005.7	49.8
9008	OCT	5	0100.6	63.5
9020	OCT	6	0000.5	48.5
9033	OCT	7	0055.5	62.2
9046	OCT	8	0150.4	76.0
9058	OCT	9	0050.3	60.9
9071	OCT	10	0145.3	74.7
9083	OCT	11	0045.2	59.7
9096	OCT	12	0140.1	73.4
9108	OCT	13	0040.1	58.4
9121	OCT	14	0135.0	72.1
9133	OCT	15	0034.9	57.1
9146	OCT	16	0129.9	70.8
9158	OCT	17	0029.8	55.8
9171	OCT	18	0124.7	69.5
9183	OCT	19	0024.7	54.5
9196	OCT	20	0119.6	68.3
9208	OCT	21	0019.5	53.2
9221	OCT	22	0114.5	67.0
9233	OCT	23	0014.4	52.0
9246	OCT	24	0109.3	65.7
9258	OCT	25	0009.3	50.7
9271	OCT	26	0104.2	64.4
9283	OCT	27	0004.1	49.4
9296	OCT	28	0059.0	63.1
9309	OCT	29	0154.0	76.9
9321	OCT	30	0053.9	61.8
9334	OCT	31	0148.8	75.6

REV	DATE		TIME Z	LONG W
9346	NOV	1	0048.8	60.6
9359	NOV	2	0143.7	74.3
9371	NOV	3	0043.6	59.3
9384	NOV	4	0138.6	73.0
9396	NOV	5	0038.5	58.0
9409	NOV	6	0133.4	71.7
9421	NOV	7	0033.4	56.7
9434	NOV	8	0128.3	70.5
9446	NOV	9	0028.2	55.4
9459	NOV	10	0123.2	69.2
9471	NOV	11	0023.1	54.2
9484	NOV	12	0118.0	67.9
9496	NOV	13	0018.0	52.9
9509	NOV	14	0112.9	66.6
9521	NOV	15	0012.8	51.6
9534	NOV	16	0107.7	65.3
9546	NOV	17	0007.7	50.3
9559	NOV	18	0102.6	64.0
9571	NOV	19	0002.5	49.0
9584	NOV	20	0057.5	62.8
9597	NOV	21	0152.4	76.5
9609	NOV	22	0052.3	61.5
9622	NOV	23	0147.3	75.2
9634	NOV	24	0047.2	60.2
9647	NOV	25	0142.1	73.9
9659	NOV	26	0042.1	58.9
9672	NOV	27	0137.0	72.6
9684	NOV	28	0036.9	57.6
9697	NOV	29	0131.9	71.4
9709	NOV	30	0031.8	56.3

REV	DATE		TIME Z	LONG W
9722	DEC	1	0126.7	70.1
9734	DEC	2	0026.7	55.1
9747	DEC	3	0121.6	68.8
9759	DEC	4	0021.5	53.8
9772	DEC	5	0116.5	67.5
9784	DEC	6	0016.4	52.5
9797	DEC	7	0111.3	66.2
9809	DEC	8	0011.2	51.2
9822	DEC	9	0106.2	64.9
9834	DEC	10	0006.1	49.9
9847	DEC	11	0101.0	63.7
9859	DEC	12	0001.0	48.6
9872	DEC	13	0055.9	62.4
9885	DEC	14	0150.8	76.1
9897	DEC	15	0050.8	61.1
9910	DEC	16	0145.7	74.8
9922	DEC	17	0045.6	59.8
9935	DEC	18	0140.6	73.5
9947	DEC	19	0040.5	58.5
9960	DEC	20	0135.4	72.3
9972	DEC	21	0035.4	57.3
9985	DEC	22	0130.3	71.0
9997	DEC	23	0030.2	56.0
10010	DEC	24	0125.2	69.7
10022	DEC	25	0025.1	54.7
10035	DEC	26	0120.0	68.4
10047	DEC	27	0020.0	53.4
10060	DEC	28	0114.9	67.1
10072	DEC	29	0014.8	52.1
10085	DEC	30	0109.7	65.9
10097	DEC	31	0009.7	50.8

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REV	DATE		TIME Z	LONG W
10110	JAN	1	0104.6	64.6
10122	JAN	2	0004.5	49.6
10135	JAN	3	0059.5	63.3
10148	JAN	4	0154.4	77.0
10160	JAN	5	0054.3	62.0
10173	JAN	6	0149.3	75.7
10185	JAN	7	0049.2	60.7
10198	JAN	8	0144.1	74.5
10210	JAN	9	0044.1	59.4
10223	JAN	10	0139.0	73.2
10235	JAN	11	0038.9	58.2
10248	JAN	12	0133.9	71.9
10260	JAN	13	0033.8	56.9
10273	JAN	14	0128.7	70.6
10285	JAN	15	0028.7	55.6

REV	DATE		TIME Z	LONG W
10298	JAN	16	0123.6	69.3
10310	JAN	17	0023.5	54.3
10323	JAN	18	0118.4	68.0
10335	JAN	19	0018.4	53.0
10348	JAN	20	0113.3	66.8
10360	JAN	21	0013.2	51.7
10373	JAN	22	0108.2	65.5
10385	JAN	23	0008.1	50.5
10398	JAN	24	0103.0	64.2
10410	JAN	25	0003.0	49.2
10423	JAN	26	0057.9	62.9
10436	JAN	27	0152.8	76.6
10448	JAN	28	0052.8	61.6
10461	JAN	29	0147.7	75.4
10473	JAN	30	0047.6	60.3
10486	JAN	31	0142.6	74.1

REV	DATE		TIME Z	LONG W
10498	FEB	1	0042.5	59.1
10511	FEB	2	0137.4	72.8
10523	FEB	3	0037.4	57.8
10536	FEB	4	0132.3	71.5
10548	FEB	5	0032.2	56.5
10561	FEB	6	0127.2	70.2
10573	FEB	7	0027.1	55.2
10586	FEB	8	0122.0	69.0
10598	FEB	9	0021.9	53.9
10611	FEB	10	0116.9	67.7
10623	FEB	11	0016.8	52.7
10636	FEB	12	0111.7	66.4
10648	FEB	13	0011.7	51.4
10661	FEB	14	0106.6	65.1
10673	FEB	15	0006.5	50.1